Structural Analysis of Depression Indicators Scale-Children and Adolescents (BAID-IJ): A Bifactor-ESEM Approach

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Abstract

Depression in children and adolescents has reached alarming levels, evidencing an ever-greater need for early diagnosis of the disorder. Depression is a construct closely related to other indicators and the broad track of symptoms. The Depression Indicator Assessment Battery was developed to measure the core symptoms of depression, loneliness, helplessness, self-esteem and self-concept. Participants were 976 children and adolescents, aged 8-18 years. The data was collect from two public schools and from public mental health care services in Brazil. The internal structure was studied with the comparison of six different exploratory and confirmatory models, each one nest different assumptions. The comparison of models indicated that a latent bifactor explanatory structural equation model better explains the variance of data. The latent structure expected for the battery was confirmed, taking in account the complexity of measure correlated constructs, linking the theory to the measure.

Keyword*: Psychometric, psychological assessment, childhood depression.

Análise Estrutural da Bateria de Avaliação de Indicadores de Depresão Infantojunenil: Uma Abordagem ESEM Bifactor

Resumo

A depressão em crianças e adolescentes tem atingido níveis alarmantes, evidenciando uma necessidade cada vez maior para o diagnóstico precoce da doença. A depressão é um construto intimamente relacionado com indicadores e uma ampla faixa de sintomas. A Bateria de Avaliação de Indicadores de Depressão Infantojuvenil (BAID-IJ) foi desenvolvido para medir os sintomas nucleares da depressão, solidão, desamparo, a autoestima e autoconceito. Participaram da pesquisa 976 crianças e adolescentes de 8-18 anos. Os dados foram coletados a partir de duas escolas públicas e de serviços públicos de saúde mental no Brasil. A estrutura interna foi estudada com a comparação de seis diferentes modelos exploratórios e confirmatórios. A comparação entre os modelos indicou que a modelagem de equação estrutural do fator latente exlicou melhor a variância dos dados. A estrutura latente prevista para a bateria foi confirmada, levando em conta a complexidade da medida correlacionada construções, ligando a teoria à medida.

Palavras-chave*: Psicometrica, avaliação psicológica, depressão infantil.

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Análisis Estructural de la Depresión Indicadores Niños Escala- y Adolescentes: Un Enfoque Bifactorial-ESEM

Resumen

Depresión en niños y adolescentes ha alcanzado niveles alarmantes, lo que evidencia una cada vez mayor necesidad de un diagnóstico precoz de la enfermedad. La depresión es una construcción muy relacionado con otros indicadores y la pista amplia de síntomas. La Batería de Evaluación de Indicadores Depresión fue desarrollado para medir los principales síntomas de la depresión, la soledad, el desamparo, la autoestima y el autoconcepto. Los participantes fueron 976 niños y adolescentes, con edades entre 8-18 años. Los datos fueron cobrar de dos escuelas públicas y de los servicios públicos de salud mental en Brasil. La estructura interna se estudió con la comparación de seis modelos exploratorio y confirmatorio diferentes, cada uno de anidación supuestos diferentes. La comparación de los modelos indica que un modelo latente bifactorial exploratoria estructural ecuación, con un factor general y de cinco factores correlacionados grupos que explican mejor la varianza del instrumento. La estructura latente esperado para la batería se confirmó, teniendo en cuenta la complejidad de la medida correlacionada construcciones, vinculando la teoría con la medida.

Palabra clave: Psicometría, evaluación psicológica, depresión infantil.

According to the World Health Organization (WHO), depression can affect even very young people, reducing a person's productivity throughout life, and, possibly for this reason, it has become the leading cause of disability worldwide. In some cases, depression may become recurrent or chronic, increasing the daily difficulties, which may ultimately lead a person to commit suicide. Depression is the predominant cause of disability in children/teens aged 10 to 19 years, being among the top three causes of death among adolescents worldwide (WHO, 2014). In light of this information, we advocate for the construction of new psychological tests that can detect depressive symptoms in these population.

The Depression Indicators Assessment Battery-Children and Adolescents (BAID-IJ) was constructed based on the depression diagnosis criteria established by the DSM-5, considering the studies of Weinberg, Rutman, Sullivan, Pencik, and Dietz (1973) for depression; the theories of Hymel, Tarulli, Hayden Thomson, and Terrell-Deutsch (1999) for loneliness; Abransom, Seligman, and Teasdale (1978) for helplessness; Coopersmith (1967) for self-esteem; and the multidimensional model of Harter (1996) for self-concept. The proposed battery of scales aims to measure indicators of depression, loneliness, helplessness, self-esteem, and self-concept in children and adolescents of ages 8-18 years old.

Reise, Moore, and Haviland (2011) indicate that depression could be considered a complex construct and evaluate dimensionality and interpret such data can be an intricate task. Psychological measurements can often result in item responses that are consistent as well as one-dimensional (a single common factor), as multidimensional latent structures (which are usually resulting from similar content items).

Several approaches could help to address this complexity. For Simms, Grös, Watson, and O'Hara (2007), hierarchical models suggest that both components, general and specific, are necessary to full representate of the variation observed between mood disorders and anxiety. Furthermore, bifactor models specifie that there is no single general trait that explains the variance, but there are some groups of additional traits that explain the common variance in the subscales and are an alternative to non-hierarchical multidimensional constructs (Reise, Morizot, & Hays, 2007).

The aim of this study is to examine the internal structure of BAID-IJ comparing five models

structural models with different assumptions. The results will be evaluate in terms of theoretical and consistency regarding the construct measured.

Method

Participants

The study included 976 children and adolescents, aged 8-18 years old (*M*=15.16; *SD*=2.867), and the majority was female (*n* = 516; 53%). The sample was composed by children and adolescents from a mental health outpatient service, a health clinic – each of those in psychotherapeutic care had complained of emotional difficulties –, a shelter and for two public schools in the state of Minas Gerais, Brazil.

Instruments

Depression Indicator Assessment Battery-Children and Adolescents (BAID-IJ; Borges, Baptista, & Serpa, 2015). The BAID-IJ contains 91 items and assess depression (20), loneliness (17), helplessness (17), self-esteem (19) and self-concept (18). Examinee is asked to take into account his/her thoughts, feelings and behavior in the last 15 days. The items of depression, loneliness and helplessness were constructed prioritizing negative feelings, thoughts and behaviours; and the items of self-esteem and self-concept were constructed with references to positive characteristics.

Procedure

The project was submitted and approved by the Research Ethics Committee and the parents and/or guardians agreed to the participation of the children and adolescent in the research. Data collection was carried out collectively, in the classroom and during hours previously scheduled with the school administration. For the children aged 8, 9 and 10 years, the items were read aloud to avoid difficulty in comprehension.

The analyses were performed via R software (R Core Team, 2015), using the *Psych* (Revelle, 2015) and *Sampling* (Tillé & Matei, 2013) packages, and Mplus-version 6.11 (Muthén & Muth-

én, 2010). The sample was splitted randomly in two groups with similar demographic characteristics to enable the exploratory and confirmatory analysis.

First, was tested how many factors could explain the test underline structure using the parallel analysis procedure (Horn, 1965), using the polychoric matrix to evaluate the set of items. Second, two factorial analyses were conducted with all items, the first considering a unidimensional structure and the second, a five correlated factor structure, using oblimin rotation. After that, a bifactor exploratory analysis model was performed by structural equation (B-ESEM). This model is less restrictive than the traditional bifactorial model in allowing items to saturate in more than one factor; it is more adequate for correlated group structures (Reise et al., 2011).

In addition, four additional models were designed: one was a confirmatory factor analysis model considering the five uncorrelated latent factors (CFA-5D), one with the five correlated latent factors (CFA-5), a model with the five uncorrelated latent factors and a hierarchical general factor (H-CFA-D); one with the five correlated latent factors and as a hierarchical general factor (H-CFA), and a classic bifactor model (B-Factor) with the Schmid and Leiman orthogonalization method,with five specific factors and one general factor. For all models we used the WLSMV estimator, except for the B-ESEM when the TARGET rotation was chosen, as recommended by Reise et al. (2011).

Results

The parallel analysis employed both principal components and principal axis factor analysis as the extraction methods. The graphical analysis lead to the evidence that a factorial structure exists underlying the scale. For all items of the five subscales (depression, loneliness, helplessness, self-esteem and self-concept) was observed a common dimension. The subscales are also unidimensional when observed independently. This result lead us to some question: How do we could interpret this complex structure or address this information in an exploratory model?

After that, a configural structure from three exploratory models with different assumptions was compared: (a) An unidimensional model underlying all items; (b) a 5-factor analysis, with an oblique configuration; (c) and a B-ESEM model. Table 1 shows the similarity between the factor loadings of the unidimensional model and the general factor of the B-ESEM model. A reasonable recovery of the five factors model could be seen, providing further evidence of a structure similar to B-ESEM.

Table 1
Comparison between Factor Analysis and Bifactor ESEM Models

Items	unidimensional	Five Correlated factors					B-ESEM (target rotation)					
		F1	F2	F3	F4	F5	G	F1	F2	F3	F4	F5
dep1	0.34	0.42					0.362	0.400				
dep2	0.31	0.42					0.334	0.422				
dep3	0.46	0.40					0.463	0.328				
dep4												
dep5	0.40	0.51					0.373	0.511				
dep6	0.52	0.57					0.544	0.564				
dep7	0.56	0.50					0.533	0.401				
dep8	0.37					0.40	0.427				-0.362	
dep9	0.44			0.46			0.474			0.479		
dep10												
dep11	0.35	0.40					0.354	0.414				
dep12	0.53						0.668	0.391				
dep13		0.32						0.309				
dep14	0.46			0.41			0.508			0.363		
dep15	0.34						0.335					
dep16		0.41						0.314				
dep17	0.35						0.378					
dep18	0.54	0.39					0.553	0.373				
dep19	0.47	0.36					0.517	0.396				
dep20	0.42			0.41			0.451			0.447		
lon1	0.59	0.47		0.32			0.566	0.362				
lon2									0.465			
lon3	0.44			0.52			0.465			0.446		
lon4	0.48			0.45			0.518		-0.311	0.505		
lon5	0.38						0.402	0.352				
lon6	0.33						0.378					
lon7	0.37		0.31				0.420					
lon8									0.480			
lon9	0.39			0.62			0.443			0.601		

| Items | unidimensional | Five Correlated factors | | | | | B-ESEM (target rotation) | | | | | |
		F1	F2	F3	F4	F5	G	F1	F2	F3	F4	F5
lon10	0.47			0.35			0.524					
lon11	0.54			0.69			0.573			0.588		
lon12							0.307					
lon13												
lon14	0.47			0.66			0.486			0.651		
lon15	0.35			0.67			0.373			0.750		
lon16	0.33			0.46			0.412			0.463		
lon17										0.325		
hel1	0.48						0.539					
hel2	0.47	0.47					0.483	0.346	0.372			
des3	0.35						0.403					
hel4	0.51			0.41			0.593			0.359		
hel5	0.35						0.409					
hel6	0.32					0.50	0.442				-0.408	
hel7	0.34						0.423					
hel8									0.431			
hel9		0.36					0.305		0.511			
hel10	0.56	0.42					0.578	0.356				
hel11	0.57		0.37				0.707					
hel12	0.55						0.579					
hel13	0.45		0.43				0.617					
hel14	0.31		0.36				0.373					
hel15	0.56		0.45				0.631					
hel16	0.35						0.407					
hel17	0.51			0.50			0.573			0.379		
est1	0.52				0.45		0.571					
est2	0.46				0.40		0.566					
est3	0.37				0.33		0.477					
est4	0.32						0.418					
est5	0.46				0.36		0.563					
est6	0.63				0.73		0.754				0.412	
est7	0.56				0.57		0.639					
est8	0.33						0.495					
est9	0.51				0.46		0.600					
est10	0.56				0.71		0.627					0.383

Items	unidimensional	Five Correlated factors					B-ESEM (target rotation)					
		F1	F2	F3	F4	F5	G	F1	F2	F3	F4	F5
est11	0.46					0.61	0.623				-0.320	
est12	0.57			0.33			0.702					
est13	0.41					0.81	0.604				-0.509	
est14	0.42					0.63	0.579				-0.403	
est15	0.32					0.52	0.457				-0.324	
est16	0.46				0.49		0.628					
est17					0.32		0.354					
est18	0.62				0.59		0.762					
est19												
con1	0.46					0.80	0.664				-0.493	
con2	0.39					0.62	0.550				-0.407	
con3	0.36					0.65	0.522				-0.461	
con4						0.49	0.470	-0.340		-0.307		
con5	0.34				0.39		0.308					0.751
con6	0.34				0.32		0.325					0.738
con7	0.59				0.77		0.640					0.460
con8	0.44				0.56		0.553					0.390
con9	0.53			0.33			0.670					
con10	0.54			0.47			0.590			0.339		0.394
con11	0.42			0.52			0.472			0.372		0.370
con12	0.32			0.36			0.449	-0.397				
con13	0.65				0.74		0.767				0.395	
con14	0.57				0.81		0.632					0.485
con15					0.43		0.352					
con16												
con17	0.36						0.510	-0.304				
con18						0.55	0.406					
Explained Variance	0.18											

Note. G = general factor; F1/DEP = depression; F2/HEL = helplessness; F3/SOL = loneliness; F4/EST = self-esteem; F5/CON = self-concept.

In a second step, was build concurrent models to take in consideration different assumptions of the latent structure organization of BAID-IJ. As noted in Table 2, among the six models (CFA-5D, CFA-5, H-CFA-D, H-CFA, B-ESEM and B-Factor), the B-ESEM model shows the best fit. The B-ESEM shows CFI = 0.950 and TLI = 0.942, and the indices are considered good (Hu & Bentler, 1999). The root mean square of approximation (RMSEA) was to 0.025 [0.023-0.027], which suggests an adequate index.

Table 2
Model's Goodness of Fit

Model	χ^2	df	CFI	TLI	RMSEA	RMSEA 90% CI
CFA-5D	22716.732*	4026	0.200	0.186	0.098	[0.096-0.099]
CFA-5	16018.267*	4016	0.486	0.476	0.078	[0.077-0.080]
H-CFA-D	8783.497*	3999	0.796	0.791	0.050	[0.048-0.051]
H-CFA	7655.149*	3995	0.844	0.840	0.043	[0.042-0.045]
B-Factor	16484.932*	3946	0.399	0.376	0.081	[0.079-0.082]
B-ESEM	4611.187*	3560	0.950	0.942	0.025	[0.023-0.027]

*p = .001.

Discussion

First, it is important to emphasize some advantages of using the bifactor model (Reise et al., 2011). This model allows researchers to measure individuals on a single trait and control the distorting effects of multidimensionality caused by, for example bias in items or non-modelled psychological constructs, regarding differences in the groups. Also, it enables the study on the contribution of general factors and external variables groups and the comparison between unidimensional and multidimensional models to evaluate distortions in the estimates of the model.

Results showed that the BAID-IJ has a complex structure and an underlying latent trait to all scales. Theoretically, the general factor can be interpreted as a general latent trait underlying the constructs and is correlated with depression, loneliness, helplessness, self-esteem and self-concept (American Psychiatric Association [APA], 2014; Seligman, 1967; Weinberg et al. 1973). The descriptors of depression used for the diagnosis of depression in children and adolescents are not clearly defined in literature such as the DSM-5 (APA, 2014), which uses the same diagnostic criteria in adults, stressing only two specific descriptors to the youth population (irritability and unexpected weight based on age).

The results showed at table 1 that some items charged positively at general factor ands positively and negatively at specific factors. It

is possible to understand that the item explains the general factor "depression", its specific factor and also is related with other construtos. Depression is deeply linked to other construtos, even positively as negatively and this theoretical union demands efforts to be dismembered. For example, item lon4 "I prefer to be alone at familiar meeting" received positive loading at general factor, negative loadings at F2 (helplessness) and positive at F3 (loneliness). In other words, the item represents depression and loneliness, but, it is possible to understand that loneliness is theoretically related with helplessness. New collects with new samples and similar analysis will be necessary to assess if loadings keep the same, besides, other pilot group will be necessary to asses the comprehension of the items is happening in a correct way.

Some items are loaded with two or three different factors, specifically the self-deprecating constructs related to depression (Weinberg et al., 1973), self-esteem and self-concept. Rosenberg (1979) characterized self-esteem as one of the factors that make up the self-concept. Therefore, it is possible to point out that the difficulty of construct definition can often interfere with the analysis, whether from the item construction process or defining the content. The results obtained for this sample raises the question: to what extent are self-esteem and self-concept correlated to depression?

The evidence suggested a latent bifactor structure for the BAID-IJ. However, according theory, the subscales are not independent and the

adoption of a conventional bifactor model would not attend to the theoretical criteria and statistical adjustment. The Bifactor-ESEM model relaxes the assumption of group independence and admits the correlation between them, moddeling the variance distribution of the items as a function of conceptual proximity among the constructs. It is important to highlight that this was a preliminary study of the battery and is not yet conclusive. The authors intend to include the measurement scales of hopelessness and self-efficacy in BAID-IJ, understanding the importance of the relationship between these constructs and depression.

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